Asian Nursing Research 9 (2015) 28–34

Contents lists available at ScienceDirect

Asian Nursing Research

journal homepage: www.asian-nursingresearch.com

Research Article

Mapping and Changing Informal Nurse Leadership Communication Pathways in a Health System

David C. Benton, PhD, RN, FRCN *

International Council of Nurses, Geneva, Switzerland

ARTICLE INFO

Article history:
Received 20 November 2013
Received in revised form
3 April 2014
Accepted 9 October 2014

Keywords:
knowledge management
leadership
social networking
team nursing

SUMMARY

Purpose: Social network analysis (SNA) is increasingly being used to provide a visual and quantitative analysis of relationships among groups of staff and other subjects of interest. This paper examines the role SNA can play in identifying existing networks, and measures the impact of participation in brief task-focused project groups on the underlying communication pathways.

Methods: An SNA of a closed group of nurse leaders was conducted in a health system in Scotland, UK. Data were collected on two occasions 6 months apart. Analysis of both whole network and individual node-based (nurse leader) measures were undertaken.

Results: Analysis revealed that the initial network structure was related to functional departments. By establishing task and finish groups, network density and other key measures could be improved.

Conclusions: SNA is a useful tool in mapping existing networks and evaluating how these can be strengthened through the use of task orientated project work. This easy-to-use technique can provide useful insights and a means of targeting management action to improve communication pathways in a moderately large and complex nurse leadership group. Further clinical and academic potential uses of the technique are suggested.

Introduction

The purpose of this study was to examine the role that social network analysis (SNA) can play in identifying and altering communication pathways within nursing leadership in a single health system in Scotland.

In today's rapidly changing health care delivery environment, organizational redesign, mergers, efficiency targets and performance benchmarks are all terms familiar to many nurse leaders [1]. While getting to grips with these challenges, newly appointed nurse directors often initially find it difficult to navigate large and increasingly complex organizational structures. These structures often place the nurse director in a leadership role where they have no direct reports. In such circumstances they have to use their influencing skills to bring about professional change. At the other extreme, they can have unrealistically large spans of control brought about as a result of deletion of middle managerial positions. In the latter case the newly appointed director can face frequent demands for day-to-day management and guidance support that can consume a great deal of time and energy [2].

Hatala and Lutta [3] have noted that it is widely accepted that information sharing and effective communication is central to successful organizational functioning. Van den Bulte and Wuyts [4] have stressed the positive impact that word-of-mouth communication between colleagues can have. Van den Bulte and Wuyts also suggested that the judicious use of such pathways should not be underestimated as a potentially powerful communications tool [4]. Additionally, Morberg et al. [5] and Hoppe and Reinelt [6] have highlighted the centrality of information management as a key approach to securing organizational success in increasingly competitive and demanding environments. At this time of almost constant change, it is useful to recall the work of Rogers [7] who repeatedly identified the impact on increased early adoption of innovation when the opinion leaders at the center of organizational networks were themselves early adopters. These authors have one thing in common—the value they place upon communication networks.

In recent years there has been an increase in the use of SNA or organizational network analysis [8]. These techniques can be a valuable approach in mapping and analysing information sharing

* Correspondence to: David C Benton, PhD, RN, FRCN, International Council of Nurses, 3 Place Jean-Marteau, Geneva 1201, Switzerland.
E-mail address: dcbenton.swiss@gmail.com

http://dx.doi.org/10.1016/j.anr.2014.10.006
p1976-1317 e2093-7482/Copyright © 2015, Korean Society of Nursing Science. Published by Elsevier. All rights reserved.

structures [9,10]. SNA can identify those members of staff who play pivotal roles in either the transmission or blocking of information. Hence, with today's pressure to deliver results, newly appointed nurse directors need to find ways to leverage established networks. According to Cross and Thomas [11], from data collected in the corporate sector, information flows and organizational performance can be greatly improved by making a few well-placed changes to the structure of the social network within an organization. Although these results were based on work in the corporate sector they do beg the question as to whether SNA may be a useful tool for elaborating information flow amongst nurse leaders, and if their underlying network structures can also, through some form of intervention, be changed for the better.

Defining key terms

Central to the construction and analysis of social networks is familiarity with a number of key terms and measures [12]. It is not the intention to provide a comprehensive description of all measures that can be used for SNA in this paper as these can be found in a number of methodological texts on the subject [5,9,13]. Instead, only those terms and measures used by the investigator and commonly identified by other researchers as being useful in exploring organizational performance and measurement of change are described [14–18].

The focus of any SNA is based upon an examination of "nodes/actors". A node is the term used to describe the person, species or organization under investigation. The connection of one node to another, by use of a connecting line (tie), indicates a flow of information. The flow can be either unidirectional, from node A to node B, or bidirectional where information flows in both directions. The direction of the flow of information is indicated by the presence of an arrowhead starting at the originator of the communication and pointing to the recipient. The "indegree" of a node or actor is the number of people who go to that person for information and the "outdegree" of a node or actor is the number of people that they go to for information. The measurement of indegree can be used to identify those actors who are most sought out for information. A high outdegree score can indicate individuals with a good understanding of where particular expertise lies within the network. These two scores can be combined to form the measure "degree connectedness", which provides an indication of how easily a particular actor communicates with other members of the network thereby offering an indication of power and potential influence. "Closeness centrality" is a measure of the extent to which an individual node is connected to all other nodes and is an indicator of the extensiveness of involvement in communication relationships with other actors. "Betweenness" is used to identify which of the actors in a network are brokers of information between otherwise poorly connected groups or subgroups of people. Cross and Thomas [11] assert that, although brokers may not have the most number of connections in a network, their pivotal function in connecting subgroups make identification of such members important when considering the overall effectiveness of information flow.

There are a number of measures that can be used to assess the health of a network. "Network density", which is the number of actual connections divided by the potential total number, provides a measure of the extent of the interactions within the structure and can be used to assess the degree to which a group is likely to be viewed as inclusive [9].

Another useful measure in examining network topography is the "average path length". This concept is defined as the average number of steps along the shortest paths for all possible connections of pairs of individuals in the network. It is a measure of the efficiency of information flow of a network. The lower the number the more efficient information flows across the topography.

The "network diameter" of a social network is the number of links in the shortest path between the furthest pair of nodes. It therefore provides a measure of how expansive a network is and the number of transmission steps it will take to ensure information is fully communicated to all individuals.

Methods

This quasi-experimental, pre-post intervention design study focused on a defined group of nurse leaders working within an integrated health system. The study entailed after the initial data collection the use of an intervention where three groups worked independently to complete one of three educational tasks constructed to influence the underlying social network structure as documented by pre-intervention data collection.

Setting and sample

The health system located in the North East of Scotland encompassed a number of hospital sites ranging from small rural units (cottage hospitals) right up to and including a multisite university teaching hospital including tertiary specialist services. In addition, as the delivery system was fully integrated, the responsibilities of the nurse director also encompassed all community-based nursing services such as school nursing, district nursing teams, community midwifery and health visitor services.

Subjects recruited to the study were nurse leaders who were operationally defined as any nurse, who occupied a management position and who had responsibility for the professional leadership and supervision of nurses, in three or more wards, departments, services or community based teams. The entire population of nurse leaders working in the health system who met the inclusion criteria were invited to participate.

Ethical considerations

SNA is said to have a number of specific ethical challenges. Borgatti and Molina [19] have fully explored these issues, and offered explicit guidance on this important issue in their seminal paper on the ethics of conducting network research within organizations. This guidance relating to protecting anonymity, presenting data in aggregated form and offering multiple opportunities to opt-out of the study was carefully followed.

Approval for the study was sought from three different sources: the ethics committee, which normally focuses exclusively on clinical research involving human subjects; the senior management team for the health system to secure employer perspective support; and the staff representative body who are guardians of employee rights. All three entities gave approval.

Each subject received an explanation of the study and, in particular, how data would be collected, and fed back to participants. All potential subjects were given the option to decline participation and a written agreement to their participation was obtained prior to commencement of data collection. Furthermore, participants were advised that anonymity would be protected by use of numbers rather than names in any visualizations of the network or in the reporting of any analysis.

Instruments

Participants were given a pen and paper based self-completion questionnaire. The questionnaire took 3–5 minutes to complete. As recommended by Clark [10] the data collection instrument was

very straight forward and simply provided the following statement which for anonymity purposes uses a fictitious name, "I get work related information from John Smith—once a day, at least once a week, at least once a month, never or very rarely". Each participant was asked to answer this question in relation to all those who had agreed to participate in the study. Scores of 3, 2, 1, and 0 were awarded on the basis of frequency of information exchange (tie strength). The most frequent exchanges, "once a day", were awarded a score of 3 and for "never or very rarely", a score of 0. This approach allowed for a closer examination of the different subnetworks (cliques) by stepping through the different levels of relationship to effectively isolate only strong ties (high frequency communication).

Secondly, as part of the same instrument, participants were asked to indicate which of three topics they had expertise in or an interest in learning more about. These preferences were used to select participants for the intervention described below. The topics had been identified as part of work relating to the development of a strategic plan for nursing in the organization. Specifically, they focused on identifying the continuing education needs of the leadership group: searching out and describing examples of best clinical practice occurring within the health system, and highlighting areas that could form a focus for improving quality of service provision. Prior to distribution, the instrument was piloted with nurses from an adjoining health system and was found to be clear and easy to complete and therefore required no amendments before use with the research sample.

Data collection procedure

By having a clear operational definition of nurse leader it was possible to identify and undertake a bounded network survey, that is, only those members of the organization that met the inclusion criteria were approached. This resulted in a total of 51 potential subjects who were invited to participate in the study. The study gathered data on two separate occasions 6 months apart.

Feedback, educational task and finish intervention

Immediately after the initial data collection the results of the existing network structure were fed back (within 2 weeks) to the subjects. At that point three task and finish groups were established (Group 1, identifying continuing education needs; Group 2, describing examples of best clinical practice; and Group 3, highlighting opportunities for improving quality). Each task and finish group was composed of six nurse leaders selected on the basis of their areas of expressed expertise/interest and on being identified through the initial network analysis as being only weakly connected to each other and the network as a whole. Each of the groups was asked to examine one of the topics and requested to report their findings within 12 weeks to the entire nurse leadership group. Specifically, they were asked to identify what was already known or in place within the organization relating to the topic (this meant that they had to investigate and communicate widely). Then they had to agree on priorities for action so as to promote existing successes and address any weaknesses. In short, in terms of the research design, the task and finish groups were established to deliver a meaningful contribution to advancing the organization's strategic plan and, more importantly, to provide a potential vehicle for strengthening the social network within the organization.

Six months after the initial mapping of the network, having completed the task and finish group activity, subjects were again asked to answer the same question relating to frequency of information exchange within the network.

Data analysis

UCINET 6, a specialist package that can calculate the various measures of interest such as indegree, outdegree and centrality, was used to generate quantitative results. In addition, NETDRAW was used to seamlessly import the processed data from UCINET 6 (Analytic Technologies, Lexington, KY 40513, USA) and then create network maps to help visualize the connections between the various nodes. Both packages can be downloaded from http://www.analytictech.com/ucinet/description.htm.

Results

Of the 51 potential nurse leaders who were approached to participate in the study, 46 agreed and completed both the initial and follow-up instruments giving a response rate of 90.2%. On the first data collection, a further two sets of data were obtained. However, due to retirement of one subject and illness of another, a second set of data for these two subjects was missing. Hence, to enable a more accurate comparison between the pre-intervention and post-intervention phases, data from these individuals were excluded from the analysis, although both individuals did participate in the initial internal feedback to participants after the baseline data collection. The 46 respondents were mainly female (91.3%) and ranged in age from 28 to 63 years with a mean age of 47 years.

From simple inspection of the visualizations of the two networks (Figures 1 and 2), it can be seen that, in general terms, individuals were more closely connected to colleagues from within the same work area. This was particularly the case prior to the task and finish intervention. Different shapes were used to indicate the various departments (areas of work) to which the individual belonged. Also, in the case of Figure 1, boundaries have been drawn around three distinct subnetworks (the community, women and paediatrics, and acute hospital services that encompass medicine, surgery, elderly and specialist services). It should also be noted that these three subnets were connected extensively through the director of nursing.

Figure 1 illustrates that there was one individual from the community (no. 43) who was not connected to the network at the strong tie level. Similarly, there were two "pendant" nodes (11 and 45) who were connected only via a single tie.

Data collected 6 months after the initial data collection and subsequent to the completion of the task and finish groups (Figure 2) revealed that nurse leaders had a wider range of ties spanning the various areas of work. The community group, although better connected to the rest of the nurse leaders, remained less well integrated into the overall network. However all the community leaders were connected and there were no "isolates" or "pendant ties" members.

Examination of the network level data (Table 1) highlighted that there had been improvements in all three measures. The increase in network density from 0.471 to 0.521, representing a 10.6% improvement, confirms the impression from the visualization of Figure 2 of an increase in the total number of ties. The reduction in both average path length and overall network diameter is suggestive of a network structure where information has shorter distances to travel indicating a more connected group of individuals.

Discussion

Whilst visual inspection of Figures 1 and 2 provided a degree of insight into the changes to the network structure that took place between time one (baseline measurement) and time two (post-intervention), closer examination of the quantitative data

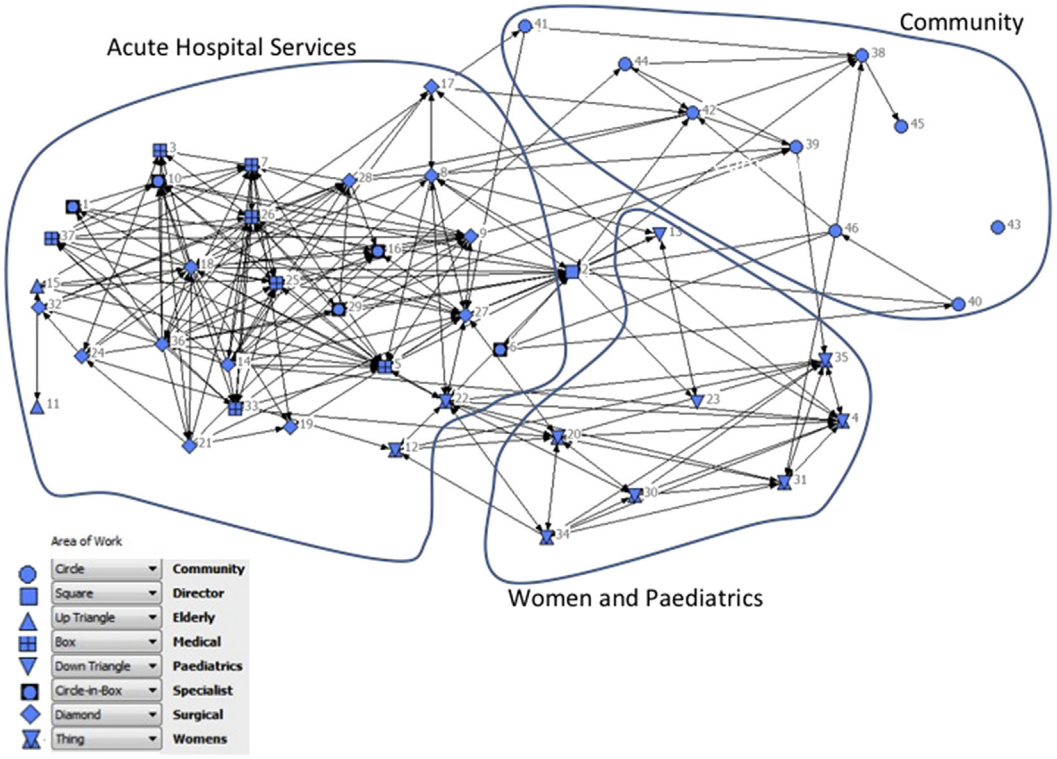

Figure 1. Visualization of strong ties before task and finish groups.

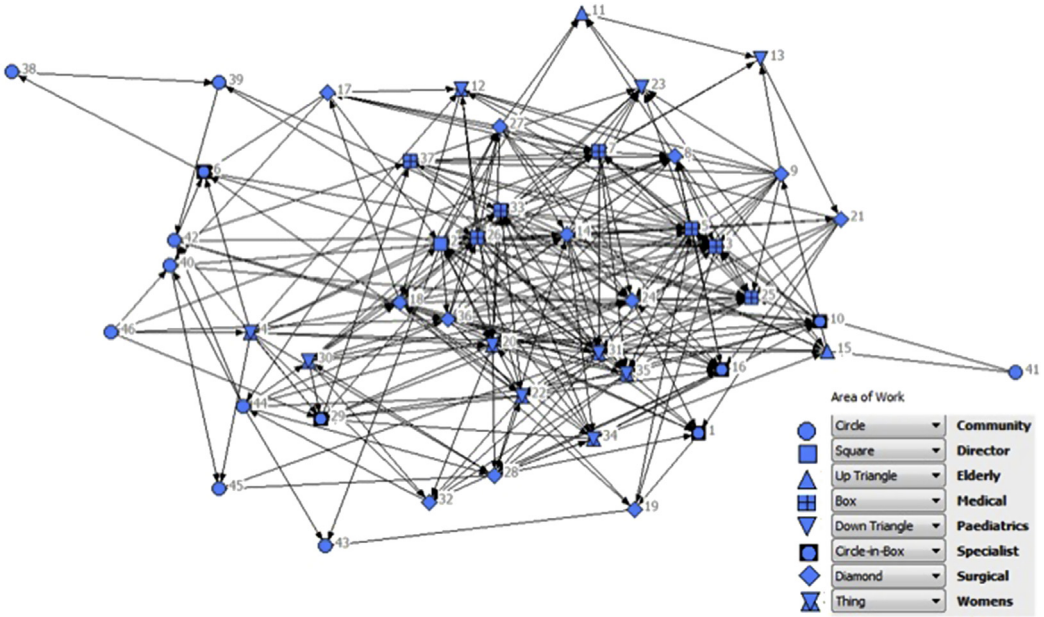

Figure 2. Visualization of strong ties after task and finish groups.

Table 1 *Summary of Network Level Measure of Performance.*

Network measures	Time 1 data collection	Time 2 data collection
Network density	0.47	0.52
Average path length	1.58	1.48
Network diameter	4.00	3.00

presented in Table 1 offered a far more detailed understanding of the impact of the task and finish intervention.

From the quantitative perspective, postintervention, a more connected group (10.6% increase in ties) and a slightly more efficient network (reduction in average path length and network diameter) can be found which the author suggests may be attributed to three features. Firstly, participation at the initial feedback session stimulated participants' interest to see their individual

Table 2 *Broker Subtypes of Nurses with High Pre-intervention Betweenness Scores.*

ID no.	Areas connected	Broker type	Pre intervention betweenness score	Postintervention betweenness score
2	Director, community, specialist, medical, Surgical, paediatrics, women & elderly	Liaison	3.18	1.19
6	Community, specialist & director	Consultant, liaison	2.62	0.72
9	Community, surgical, medical, elderly & director	Liaison, representative	2.42	0.63
20	Medical, community & surgical	Gate-keeper, liaison	2.43	0.65
27	Paediatrics, medical, women, surgical & community	Liaison	2.22	0.36
33	Surgical, medical & women	Liaison, representative	2.28	0.72
46	Community, women & medical.	Liaison, representative	2.50	0.60

location in the network. They asked about the significance of their location and how it might be changed. Secondly, on hearing the expertise of their colleagues, several participants were prompted to reach out and take advantage of this, asking their colleagues with similar interests for advice. Thirdly, the task and finish activities provided a platform for individuals who were previously poorly connected to the network to work with colleagues from other work areas.

During the initial network feedback session another structural feature was also discussed. The acute hospital services network was the most connected of the three subnetworks. This level of connectivity between distinct areas of work, within the hospital services subnetwork was attributed to three factors according to the explanations given by participants. Firstly, patients were often moved from one service setting to another and as a result the participants would have inter-area patient-focused communication. Secondly, senior nursing staff in the acute services all took turns as the nursing staff shift focal point for the entire hospital services. This resulted in communication during hand-over meetings, interacting with colleagues to resolve staffing shortages and other immediate problems. Thirdly, unlike in the other settings, a substantial number of the nurses in the acute sector services had been working in the hospital for more than 10 years. Many of the participants, over these years, went to the same meetings, participated in various policy groups or attended educational sessions together.

By focusing in on individual nodes (participants in the study), it can be seen that those that had low connectedness and closeness scores (few ties) have improved their connectedness from time one to time two. Whilst the majority of participants have seen improvements in their connectedness and closeness scores, examination of the average improvement in scores for those who participated in the task and finish group compared to those who did not reveals a considerable difference. For participants in the task and finish groups their average connectedness score improved from 15.72 to 33.9; average closeness for task and finish improved from 8.76 to 13.17. The differential rates of improvement in connectedness and closeness were expected, since the intervention encouraged and facilitated increased contact between individuals who undertook the group-based activity.

Turning to the betweenness measure, seven individuals (code numbers detailed in Table 2) were identified as having high betweenness scores at time one. A high betweenness score implies

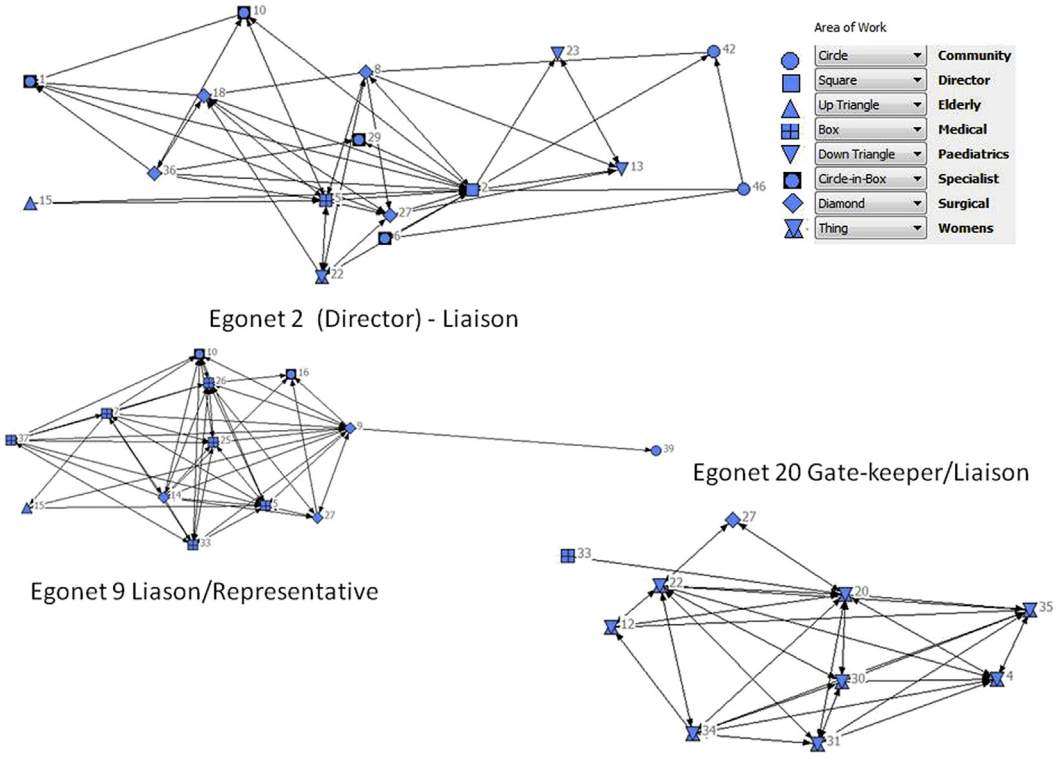

Figure 3. Visualization of three subnetworks with high betweenness scores.

that the individual played a broker role in the network, that is, they acted as a key intermediary in the flow of information. This is an important role in the network but such individuals, if overwhelmed with information, can slow down or even halt the flow of information between key individuals in the network.

According to Fernandez and Gould [20] it is possible to further differentiate the role of broker into five subtypes: (a) coordinators, who control information within the same group (X→X→X) ; (b) gate-keepers, who receive information from another group and transmit it to their own group (Y→X→X); (c) representatives, who take information from their own group and pass it to a second group (X→X→Y); (d) consultants, who come from another group and connect two people from the same group (Y→X→Y); and (e) liaisons, where the source, the broker and the destination are all from different groups (Y→X→Z).

However, these five subtypes rarely exist as pure archetypes, instead they often occur as hybrids. For illustrative purposes, Figure 3 visualizes the structure of three of the egonets (the sub-networks surrounding an individual of interest and to whom they are connected). Table 2 summarizes the characteristics of all seven individuals with high betweenness scores. From Table 2 it can be seen that the betweenness scores of those identified as a broker (potential choke points) have been reduced as a result of implementing the task and finish intervention. Space does not permit a full exploration of the potential that this more detailed level of analysis offers. However, a recent systematic review by Long et al. [21], who examine the various roles actors can play, coherently explores both the potential advantages and limitations of this approach. The author suggests that these results are congruent with the conclusions reached by Long et al. who propose that understanding the various roles that people play in networks can assist in understanding information flow and provide insights into how cooperation between otherwise disconnected groups can be improved [21].

Limitations

Whilst the method used in this study complied with the best-practice guidance offered by Borgatti and Molina [19], it is important to note that the results may have been influenced by the positional power held by the Director of Nursing who initiated the research. This may have resulted in responses from the participants framed to place the individual in a positive light (inflating the number and frequency of ties reported). This limitation could be addressed by asking the corollary of the question posed, namely, instead of asking who a person gets information from, they are asked to also note who they feel they give information to. By cross-referencing these two questions triangulated data could be obtained and, as a result, assist in the identification of response bias.

Although the second data collection took place 2 months after the completion of the task and finish groups, it is unknown whether the impact on network topology of such an intervention, although clearly positive in the short-term, would be sustained over time. Accordingly, there may be value in conducting a further survey, perhaps 12 months after the second collection, to assess whether the impact of the intervention is maintained.

Whilst this study focused on senior leadership in the organization, it did not address information exchanges that could originate from outside the professional leadership groups such as that received from doctors or other senior clinical and managerial colleagues. In addition, no attempt was made to examine the role that ward sisters (head nurses) or individual team or service managers have in contributing to the information network of senior nurses. Considering the importance of teamwork in contemporary health systems and the apparent influence of work area on structural connectivity, investigating the social network of the multidisciplinary teams would seem to be an important next step in testing the utility of this approach to improving information flow.

Future research

Whilst the focus for this study was a single health system and its nursing leadership, the author believes that the approach has much wider potential. An analysis of multidisciplinary service teams could be conducted to examine the strengths and weaknesses of information flow and how this impacts the continuity of care and patient outcomes. Alternatively, considering an academic environment, SNA could offer important insights to the transfaculty connection or lack thereof. Increasingly, research, teaching and scholarship can often benefit from expert contributions from differing academic departments.

Conclusion

By using SNA it is possible to visualize the overall structure of a closed group of nurse leaders with relative ease. With minimal effort, central and influential individuals who act as key conduits (brokers) both for collecting and disseminating information were identified. For busy nurse managers this approach offers, with minimum effort, a quick, easy and robust way of understanding the communication pathways in their organization as well as the means of effecting positive change.

Conflict of Interest

The author declares no conflicts of interest associated with this paper.

Acknowledgments

The author wishes to thank all those senior nurses in NHS Grampian who completed the two rounds of questionnaires and engaged in the task and finish groups.

References

1. Pasmore W. Developing a leadership strategy: a critical ingredient for organizational success [Internet]. Greensboro, NC: Center for Creative Leadership; 2013 [cited 2014 January 30]. Available from: http://www.ccl.org/leadership/pdf/research/LeadershipStrategy.pdf
2. Marquis BL, Huston CJ. Leadership roles and management functions in nursing theory and application. Philadelphia, PA: Lippincott Williams and Wilkins; 2003.
3. Hatala JP, Lutta JG. Managing information sharing within an organizational setting: a social network perspective. Perform Improv Q. 2009;21:5–33. http://dx.doi.org/10.1002/piq.20036
4. Van den Bulte C, Wuyts S. Social networks and marketing. Cambridge, MA: Marketing Science Institute; 2007.
5. Morberg CR, Cutler BD, Gross A, Speh TW. Identifying antecedents of information exchange within supply chains. Int J Phys Distrib Logist Manag. 2002;32:755–70. http://dx.doi.org/10.1108/09600030210452431
6. Hoppe B, Reinelt C. Social analysis and the evaluation of leadership networks. Leadersh Q. 2010;21:600–19. http://dx.doi.org/10.1016/j.leaqua.2010.06.004
7. Rogers E. Diffusion of innovations. 5th ed. New York: The Free Press; 2003.
8. Cunningham FC, Ranmuthugala G, Plumb J, Georgiou A, Westbrook JI, Braithwaite J. Health professional networks as a vector for improving healthcare quality and safety: a systematic review. BMJ Qual Saf. 2011;021:239–49. http://dx.doi.org/10.1136/bmjqs-2011-000187
9. Scott J. Social network analysis: a handbook. 2nd ed. London, England: Sage Publications; 2000. http://dx.doi.org/10.4135/9781412985864
10. Clark L. Network mapping as a diagnostic tool [Internet]. La Paz, Bolivia: Centro Internacional de Agricultura Tropical; 2006 [cited 2010 February 15]. Available from: http://revista-redes.rediris.es/webredes/talleres/networkmapping_LC06.pdf

11. Cross R, Thomas RJ. Driving results through social networks: understanding how work leverage networks for performance and growth. San Francisco: Jossey-Bass; 2009.
12. Benton DC. Networking. Learn Disabil Pract. 1998;1:29–36. http://dx.doi.org/10.7748/ldp1998.07.1.2.29.c1414
13. Cross R, Parker A. The hidden power of social networks: understanding how work really gets done in organizations. Boston: Harvard Business School Publishing; 2004. http://dx.doi.org/10.1111/j.1467-9620.2005.00619.x
14. Burkhardt ME, Brass DJ. Changing patterns of change: the effects of a change in technology on social network structure and power. Adm Sci Q. 1990;35: 104–27. http://dx.doi.org/10.2307/2393552
15. Burt RS. Decay functions. Soc Netw. 2000;22:1–28. http://dx.doi.org/10.1016/s0378-8733(99)00015-5
16. Reagans R, Zukerman FW. Networks, diversity and productivity: the social capital of corporate R&D teams. Organ Sci. 2001;12:502–17. http://dx.doi.org/10.1287/orsc.12.4.502.10637
17. Cumming JN, Cross R. Structural properties of work groups and their consequences for performance. Soc Netw. 2003;25:197–210. http://dx.doi.org/10.1016/s0378-8733(02)00049-7
18. Sparrowe RT, Liden RC, Wayne SJ, Kraimer ML. Social networks and the performance of individuals and groups. Acad Manag J. 2001;44:316–25. http://dx.doi.org/10.2307/3069458
19. Borgatti SP, Molina JL. Towards ethical guidelines for network research in organisations. Soc Netw. 2005;27:107–17. http://dx.doi.org/10.1016/j.socnet.2005.01.004
20. Fernandez R, Gould R. A dilemma of state power: brokerage and influence in the national policy domain. Am J Sociol. 1994;99:1455–91. http://dx.doi.org/10.1086/230451
21. Long JC, Cunningham FC, Braithwaite J. Bridges, brokers and boundary spanners in collaborative networks: a systematic review. BMC Health Serv Res. 2013;13:158. http://dx.doi.org/10.1186/1472-6963-13-158